Ice Crystal Growth Rates Under Upper Troposphere Conditions

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Atmospheric conditions for growth of ice crystals (temperature and ice supersaturation) are often not well constrained and it is necessary to simulate such conditions in the laboratory to investigate such growth under well controlled conditions over many hours. The growth of ice crystals from the vapour in both prism and basal planes was observed at temperatures of -60 °C and -70 °C under ice supersaturation up to 100% (200% relative humidity) at pressures derived from the standard atmosphere in a static diffusion chamber. Crystals grew outward from a vertical glass filament, thickening in the basal plane by addition of macroscopic layers greater than 2 µm, leading to growth in the prism plane by passing of successive layers conveniently viewed by time lapse video.

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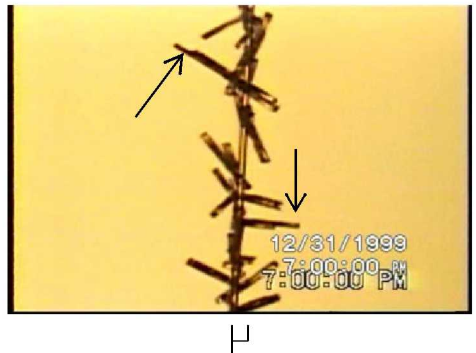
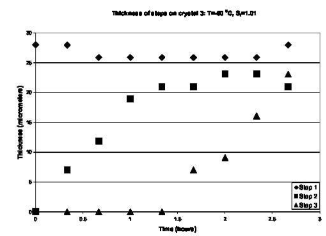
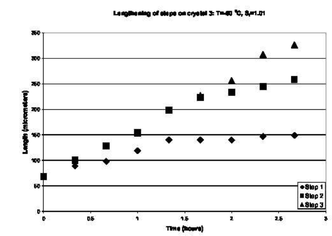
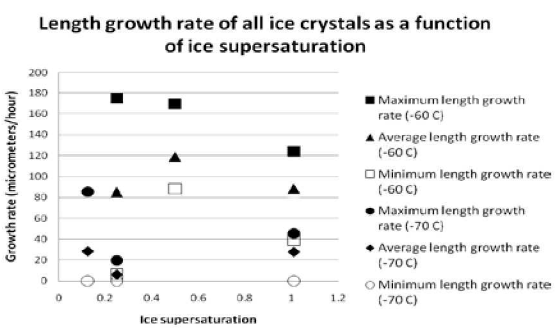


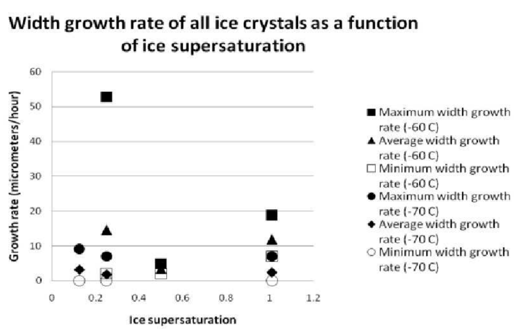
100 μm (glass thread is 50 μm); steps indicated by arrows





Step thickening (left) and lengthening (right) for growing crystal from an initial crystal size. Diamonds indicate the initial crystal (step 1), squares indicate the first step added to the crystal (step 2), and triangles indicate the second step added (step 3). The addition of a new step causes the rest of the crystal to stop thickening. After a step forms, the new step lengthens more quickly than the rest of the crystal.





Rate of growth in length (left graph) and width (right graph) of all ice crystals observed, as a function of temperature and ice supersaturation. Comparison of the two graphs shows that crystals overall lengthened faster than they thickened.

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